farther from the axis, so that it travels each second, say, 6 inches, but the chronograph sheets herewith show how satisfactory it is with present arrangement, particularly when the battery is vigorous. See particularly sheet A, and in sheet B, slight variation due to weakness of battery.

The other parts shown in diagram need little explanation. H serves to adjust the strength of the spring C, which lifts the stopping piece E; F adjusts the amount of lift, and K, when screwed down, puts E out of gear.

Two ordinary bottle bichromate batteries supply the current, and it is found that the mercury and alcohol contact is the most satisfactory, and interferes least with the rate of the controlling clock.

I have confined this description to the essential parts required to control the motion of the screw, which turns in one second, and it will be seen that the clockwork driving this may be of any form. The advantages seem to me to be (1) that one has only to make one accurate wheel, the 240-teeth worm wheel; (2) the convenience of controlling a screw that revolves in one second; (3) when correcting any error all the parts are pressing one way.

*Note.*—When testing the rate under control, a small point was fixed on the screw R (photograph A), and this made a contact at each revolution.

The photographs of the driving clock are placed in the Library.

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## *On the Orbit of* 99 *Herculis* = *Alvan Clark* 15. By J. E. Gore.

This close and difficult double star was discovered by the late Mr. Alvan Clark at Mr. Dawes's observatory in 1859. Since that year the distance between the components has diminished, and the object is now a difficult one, even with the great refractor of the Lick Observatory. The recorded measures are few, but as a measure by Mr. Burnham this year shows that the companion has described about 298° of its apparent ellipse since its discovery, I have computed the orbit, and find the following provisional elements:—

| | |
|---|---|
| $P = 53{\cdot}55$ years. | $\Omega = 50^\circ\ 5'$. |
| $T = 1885{\cdot}58$. | $\lambda = 110^\circ\ 44'$. |
| $e = 0{\cdot}7928$. | $a = 1''{\cdot}12$. |
| $i = 38^\circ\ 37'$ | $\mu = +6^\circ{\cdot}7222$. |

The following is a comparison between the measures and the positions computed from the above elements:—

| Epoch. | Observer. | $\theta_o$ | $\theta_c$ | $\theta_o-\theta_c$ | $\rho_o$ | $\rho_c$ | $\rho_o-\rho_c$ |
|---|---|---|---|---|---|---|---|
| | | ° | ° | ° | ″ | ″ | |
| 1859·63 | Dawes | 347·1 | 347·2 | −0·1 | 1·71 | 1·63 | +0·08 |
| 1878·46 | Burnham | 24·4 | 22·6 | +1·8 | 0·99 | 1·10 | −0·11 |
| 1879·468 | ,, | 26·5 | 26·3 | +0·2 | 1·13 | 1·01 | +0·12 |
| 1880·455 | ,, | 30·1 | 30·4 | −0·3 | 0·70 | 0·92 | −0·22 |
| 1880·613 | ,, | 33·1 | 31·3 | +1·8 | 0·90 | 0·90 | 0·0 |
| 1881·43 | ,, | 29·4 | 35·7 | −6·3 | 0·51 | 0·81 | −0·30 |
| 1888·733 | ,, | "Single with 36-inch refractor" | 273·7 | ... | ... | 0·60 | ... |
| 1889·502 | ,, | 281·2 | 281·2 | 0 0 | 0·65 | 0·68 | −0·03 |
| 1890·49 | ,, | 285·1 | 288·6 | −3·5 | 0·56 | 0·75 | −0·19 |

According to the above elements the minimum distance between the components occurred about 1885·50, when the position angle was 156°·75 and the distance 0″·18. The angular motion of the companion at that time was at the rate of 114° per annum, or about 1° in 3·15 days!

The primary star was measured 5·21 magnitude at Oxford, and 5·36 at Harvard, and the companion was estimated $10\frac{1}{2}$ to 12 by Burnham.

On the assumption that the combined mass of the components is equal to the mass of the Sun, the "hypothetical parallax" would be

$$\pi = a P^{-\frac{2}{3}} = 0''\cdot08.$$

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*Observations of the Variable Star R Carinæ from November, 1886, to June, 1890.* By John Tebbutt.

My last-published observations of this interesting variable are to be found in vol. xlvi. of the *Monthly Notices*, and extend from September, 1883, to April, 1886. The following are all the results which I have obtained since April, 1886, and the comparison stars are the same as employed on previous occasions. In my communication above referred to I assigned 312 days as the approximate period from maximum to maximum. Professor Chandler has since discussed the published observations of this star and has arrived at a period of 312·14 days.

*Concluded Magnitude of R. Carinæ.*

| Date. | Mag. | Date. | Mag. | Date. | Mag. |
|---|---|---|---|---|---|
| 1886, Nov. 16 | 6·5 | 1887, April 1 | 8·7 | 1887, June 21 | 8·7 |
| ,, Dec. 18 | 5·4 | ,, ,, 8 | 8·7 | ,, July 16 | 8·4 |
| ,, ,, 22 | 5·5 | ,, ,, 23 | 9·0 | ,, Oct. 22 | 5·4 |
| ,, ,, 27 | 5·5 | ,, May 9 | 9·2 | ,, Dec. 8 | 6·9 |
| 1887, Jan. 14 | 5·9 | ,, ,, 24 | 9·2 | ,, ,, 17 | 7·8 |
| ,, Mar. 17 | 8·5 | ,, June 12 | 9·1 | 1888, Jan. 2 | 8·5 |